INVESTIGATION AND EVALUATION OF A ZERO INPUT TRACKING ANALYZER (ZITA)

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THESIS

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ZERO INPUT TRACKING ANALYZER (ZITA)

by

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This study was designed to evaluate a psychomotor testing instrument known as the ZITA(Zero Input Tracking Analyzer). This instrument was being considered as a prediction device in the selection of applicants for the U. S. Navy aircrew training program. Analysis of the data obtained from six subjects (all U. S. Navy pilots) over 26 hours of testing, showed the machine capable of consistent results in

distinguishing between subjects with respect to this particular psychomotor task. A major disadvantage of the ZITA that became apparent was the amount of time (approximately 2 hours) required before learning curves were leveled out and the rate at which different individuals develop their learning curve.

Investigation and Evaluation of a Zero Input Tracking Analyzer (ZITA)

by

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ABSTRACT

This study was designed to evaluate a psychomotor testing instrument known as the ZITA (Zero Input Tracking Analyzer). This instrument was being considered as a prediction device in the selection of applicants for the U. S. Navy aircrew training program. Analysis of the data obtained from six subjects (all U. S. Navy pilots) over 26 hours of testing, showed the machine capable of consistent results in distinguishing between subjects with respect to this particular psychomotor task. A major disadvantage of the ZITA that became apparent was the amount of time (approximately 2 hours) required before learning curves were leveled out and the rate at which different individuals develop their learning curve.

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I. INTRODUCTION

A. BACKGROUND

This paper describes the evaluation of a psychomotor testing device (ZITA/ADT), and some of the underlying principle associated with it (theory of tracking, theory of time sharing, theory of short-term memory, theory of stress).

During World War II and for several years thereafter an extensive program of psychomotor research was conducted by the Army Air Force's Psychological Research Unit and the School of Aviation Medicine. Selected psychomotor tests developed under this program were an integral part of the World War II aircrew classification batteries [Melton, 1947].

Generally it was found that psychomotor measures had validity for predicting elimination from pilot training in addition to the prediction value obtained from paper-and-pencil tests. Use of psychomotor assessments for pilot selection was discontinued in the early 1950's because of the expense and difficulty of maintaining and calibrating the required equipment under decentralized testing conditions.

With recent technological and theoretical advances there has been a revival of interest in the utility of psychomotor assessments both for selection of pilot trainees and for a variety of other personnel decisions. In one study, Possey and McLaurin [1966] conducted an extensive review of work

in the perceptual-psychomotor area and provided tentative design requirements for updated psychomotor equipment and tests.

B. THEORY OF TRACKING

The scientific study of skill is evident as early as 1820 when the astronomer Bessel began to examine the differences between his colleagues and himself in the recording of star-transit times. The observer had to note the time on a clock accurately to a second and then to count seconds by the ticks of the pendulum while he watched the star cross the face of a telescope, estimating the time of crossing to the nearest tenth of a second. It was a complex task and it is not surprising that errors were made or that some observers were more skillful than others, and that substantial differences appeared when one output was compared with another. Important pioneering studies of various aspects of skilled performance continued through the nineteenth and in the early years of the present century. Many studies, such as Bryon and Horter and their work on the learning of Morse code (1897-1899), research on movement by Woodworth (1899), and the intensive work by Book on typewriters (1899) are good examples of these studies.

According to Welford /1968/, during the 1920's and 1930's the work done on skill that continued was usually done outside psychological laboratories as a part of industrial work study. The Second World War, however, brought a resurgence of interest. It was during this time period that the technical developments focused attention on human errors in that the limitations

of man and machine working together were no longer mainly in the machine but in the human operator. The full potential of the machine could sometimes be realized if the operator was rigorously selected and highly trained, but often it was clear that no amount of selection and training could ensure adequate performance. The need was therefore imperative for an understanding of the factors making for ease or difficulty in the operation of complex equipment, and this in its turn called for knowledge of many facets of human capacity and performance. It was thus that experimental psychologists come together with physiologists to take up the work alongside the engineer responsible for developing equipment.

The researches made have come to be called studies of "skill," but the word is not used in quite the same sense as it is in industry. An industrial worker is said to be skilled when he is qualified to carry out trade or craft work involving knowledge, judgment, and manual defteness, usually acquired as a result of long training, whereas an unskilled man is not expected to do anything that cannot be learned in a relatively short time. The industrial definition of skill is thus a formal one in terms of training. The psychological use of the term is wider, concerned with all the factors which go to make up a competent, expert, rapid and accurate performance. Skill in this sense thus attaches, to a greater or lesser extent, to any performance and is not limited to manual operations but covers a wide range of mental activities as well.

[Welford, 1968]

Tracking tasks have never been given explicit definition but a temporary working definition given by Adams [1961] is as follows:

1. A paced (i.e., time function) externally programmed input or command signal defines a motor response for the operator, which he performs by manipulating a control mechanism.
2. The control mechanism generates an output signal.
3. The input signal minus the output signal is the tracking error quantity and the operator's requirement is to null this error. The mode of presenting the error to the operator depends upon the particular configuration of the tracking task but, whatever the mode, the fundamental requirement of error nulling always prevails. The measure of operator proficiency ordinarily is some function of the time-based error quantity.

The usual tracking task has a visual display but there is no necessity for this. On occasion, auditary tracking tasks have been devised [Forkes, 1946; Humprey and Thompson, 1952]. The most simple and well known visual tracking task is the Rotary Pursuit Test [Melton, 1947] which employs a repetitive input signal. Tracking studies typically use more elaborate apparatus which allows for controlled manipulation of such variables as the function for the input signal, scale factors, mathematical transformations of the output signal, characteristics of the control mechanism, etc.

It has been postulated that independent variables influencing tracking behavior can be divided into two classes: task variables and procedural variables. Task variables are machine-centered. They are physical values of the tracking

device and they include such factors as the nature of the input signal, configuration of the display, design of the control system, changes in the output signal, etc. Procedural variables are man-centered. They are maniputable nontask quantities, and examples of them are instructions, number of practice trials, length of practice trial, and time between trials.

Tracking in many ways epitomises sensory-motor performance and is seen in various everyday tasks such as steering a vehicle. Precise study is, however, difficult in real-life situations so that the task was incorporated into a number of laboratory experiments aimed at the study of its essential features and designed to ascertain some of the important characteristics of the human link in systems where man and machine interact. An example of one of these experiments is shown in Fig. 1. A track, drawn on a strip of paper, passes vertically downwards past a window as shown in the drawing. The track moves irregularly from side to side of the paper and the subject attempts to follow it by moving a pen from side to side by means of a steering wheel. He observes any discrepancy between the positions of track and pen and takes action to bring the two into alignment. Any remaining discrepancy due to the correction not being adequate or to subsequent movement of the track leads to further action, and so on. Subject and machine together thus form a closed-loop, error-activated servo system in which misalignments lead to corrections and are in turn modified by them.

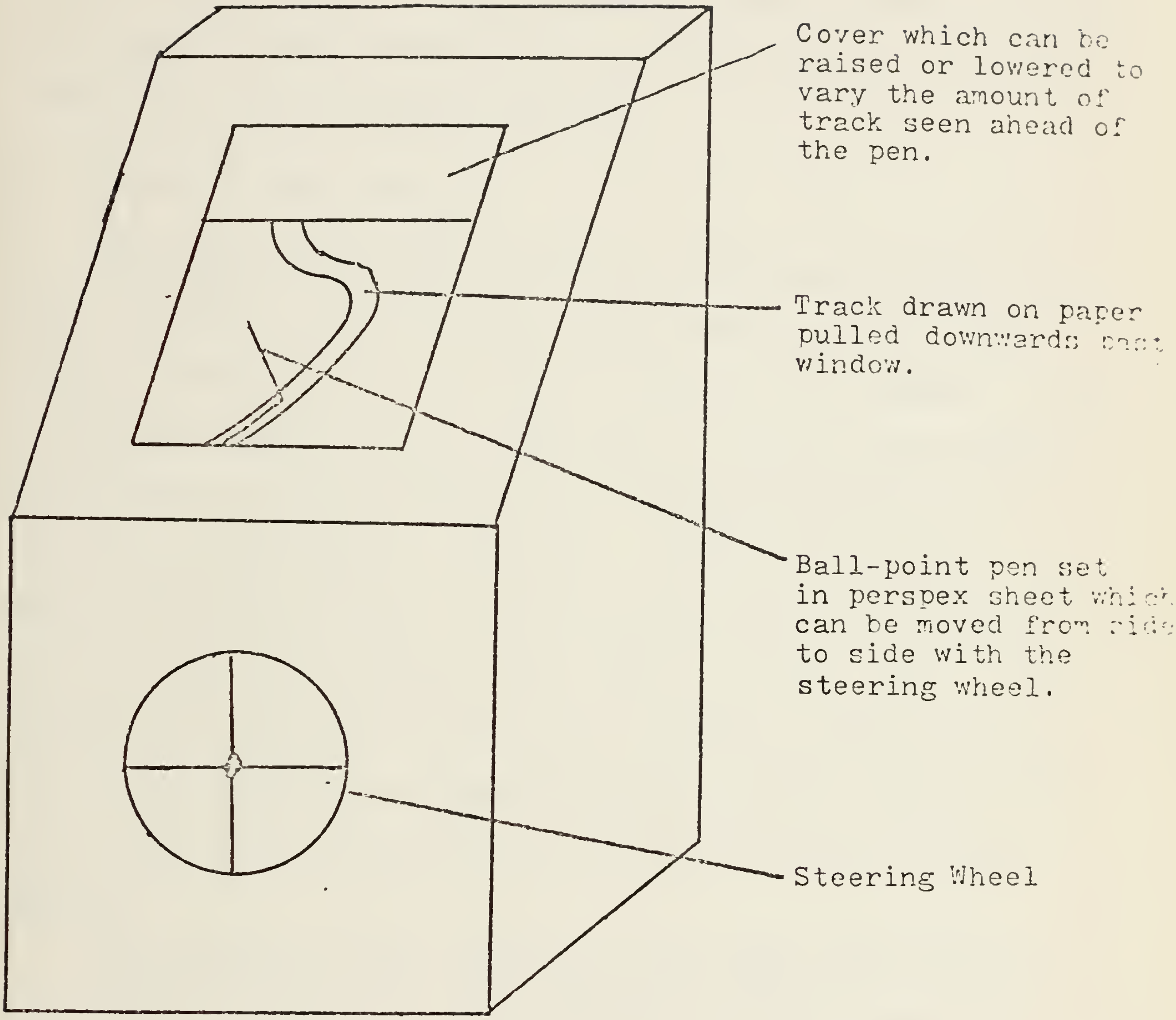

Figure 1. Tracking apparatus Designed by A. E. Earle and used in experiments by Welford [1951, 1958]

If the track in Fig. 1 is hidden from view until it reaches the pen, the subject almost inevitably tracks a little late due to a reaction time between a stimulus entering the eye and the beginning of the responding action.

C. THEORY OF TIME SHARING

Man receives information from his environment through some form of physical energy (light, sound, smell, etc.). These various types of inputs are often referred to as stimuli. This stimulus or input is then transmitted to the brain as a neural input where it is processed and retransmitted ending up as a response to the original stimulus. It may seem that man is a single processing channel limited in his ability to process events. Rather, as pointed out [Fitts & Posner, 1967], even though man does have limits to his processing capacity, he is by no means limited to processing a single event. The extent of his limitation is a function of the uncertainty of the stimuli.

Time-sharing is when potentially meaningful and relevant information may be coming from different sources though the same sensory channel or through two or even more sensory channels [McCormick, 1957]. The notion of time sharing also applies to those situations where other types of activities must be "time-shared," such as two or more manual tasks being performed at the same time. The primary problem in the time sharing of different inputs arises when two or more inputs occur simultaneously, overlap each other to some degree, or occur very close together. It seems evident

in these cases that something has to give. As reported by Adams [1961] there are four outcomes with respect to bisensory tracking performance:

1. The human operator is truly a one-channel system and, when two units of stimuli arise simultaneously, one must be temporarily stored while a response occurs to the other. At the completion of the first response, the second stimuli unit is removed from central storage and a response is made to it.

2. No storage is required. The operator is capable of simultaneously processing two event streams but there is motor interaction which prevents the two responses from simultaneously occurring with the same effectiveness that would be observed for any one of them separately.

3. No storage is required and there is no interaction of responses at the motor level. However, there is sensory interaction which results in a degradation in performance that would be absent if only one stream of stimuli were being handled.

4. Combinations of the above three possibilities.

D. THEORY OF SHORT-TERM MEMORY

After a stimulus has been received and processed, there is a period of time during which it requires the attention of the subject if it is to be preserved. This time varies depending upon the complexity of the stimuli. Fitts and Posner [1967] define short-term memory as a system which loses information rapidly in the absence of sustained attention.

Basically, the capacity of short-term memory is limited. The amount of information which can be conveyed to the subject within that limitation will depend upon the language which is used to formulated the information and the subject's skill in using that language.

E. THEORY OF STRESS

One of the concepts that has arisen in conjunction with excessive input or task demands is the ubiquitous notion of stress. In its most general form, the idea seems to be that taxing conditions are capable of reducing man's performance, not only to the level that one would expect knowing his limited processing capacity, but beyond-even to the point of response disorganization. It is though another mechanism were at work, actively disrupting performance in proportion to its level of output. This hypothetical mechanism is called stress [Howell & Goldstein, 1971]. It has been stated that any operation resulting in performance decrement and/or unpleasant or "tense" feelings is said to be producing "stress." Fitts and Posner [1967] on the other hand describe "stress" not as a condition that feels stressful to the individual, but by a specification of the demands that the environment places on the individual. Defined in this way, stress has the same meaning in testing man as it does in testing materials and machines.

Stresses beyond man's tolerance for them usually results in a change in performance and a gross generalization about stress is an obvious one; high levels of stress tend to reduce efficiency.

F. GENERAL

This paper deals with investigation and evaluation of a psychomotor testing device known as the "ZITA." This device developed by Norman K. Walker is considered as a method for measuring human performance on a wide variety of tasks under conditions of stress.

The ZITA, or Zero Input Tracking Analyzer presents to the subject a series of standardized tracking tasks. The subject is required to centralize a spot of light in the display window of a Honeywell Visicorder, using a two or three position control stick. A read-out of the accumulated error from the center position appears after 60 seconds and a permanent record of performance is given on the Visicorder read out tape. Tasks of increasing difficulty are offered by adjusting various input controls.

The ADT, or Auxiliary Distraction Task, generates a random series of bimodal pulses at two or five second intervals. The subject is to respond to the audio stimuli by pushing one of two buttons. Errors are scored, and accumulated errors are indicated on the Visicorder read out tape.

II. METHOD

A. APPARATUS

1. ZITA

The Zero Input Tracking Analyzer, ZITA, has four basic components, the signal processor, the error analyzer, the display recorder unit, and a two or three position hand control stick. The first two are combined into a single unit, the ZITA, and the display recorder consists of a Minneapolis-Honeywell Visicorder.

The ZITA theoretically provides a means of completing a servo loop between the operator's hand and a display which he is watching and attempting to control. Fig. 2 shows the elements of the loop. Apart from the mainpower there is no input to the loop; hence the signficance of "Zero Input" in the name. From the output and factors determined by the switch settings of ZITA for the particular test, a reliable measure of the performance level achieved by the operator can be obtained.

2. Visicorder

The display instrument, a Minneapolis-Honeywell Visicorder, is essentially a multi-channel recording galvanometer. It has eight mirror-type galvanometers adjustable in sensitivity individually by series and parallel resisters. The visible display is made by the light spots from the galvanometers as they move across a six inch horizontal scale. The recorded

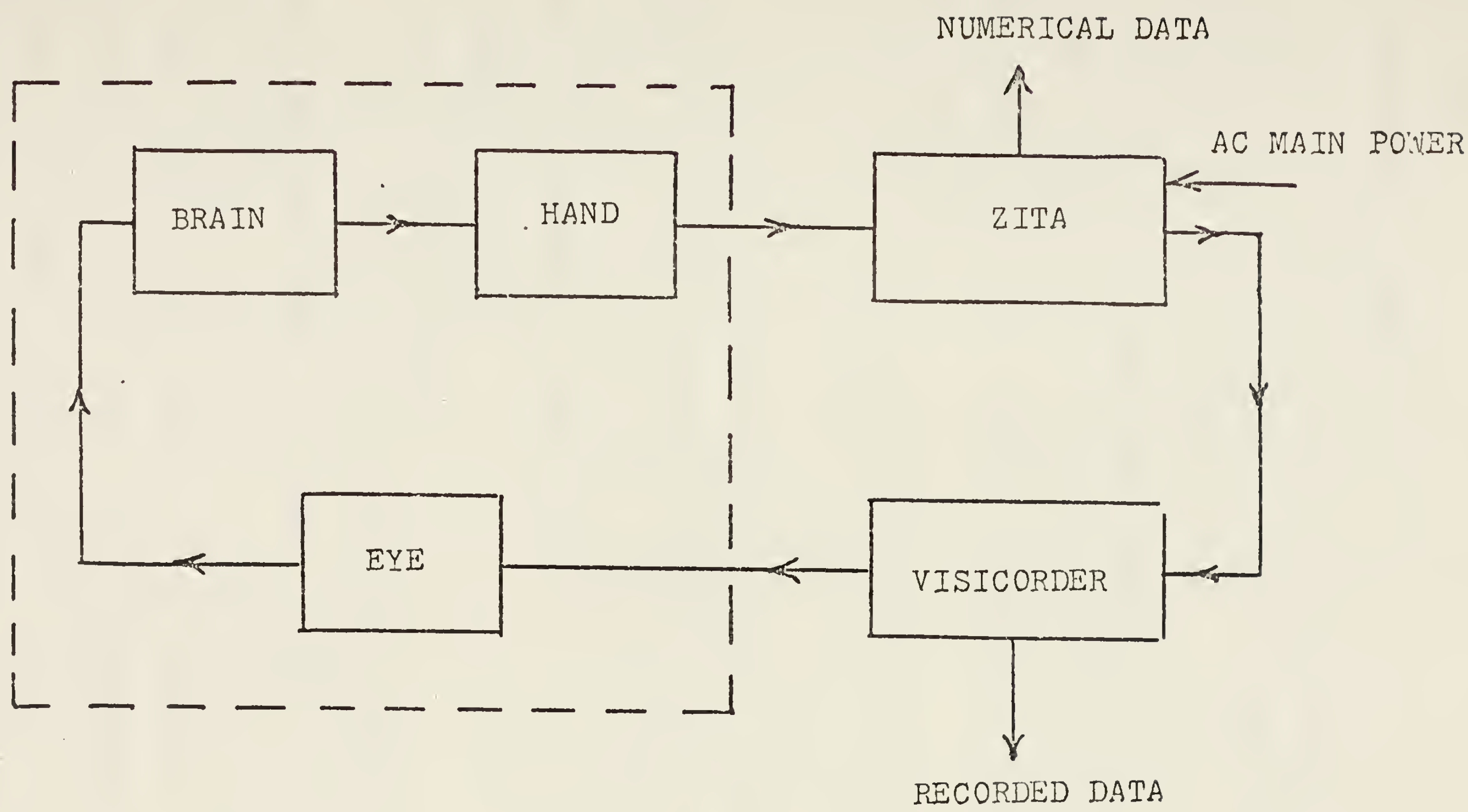

Figure 2. The Zero Input Loop

display is from traces of these same spots on photo-sensitized paper driven at a contstant speed by an independent motor and take-up system.

3. The Control Stick

The hand-operated control stick switches a d.c. voltage of plus or minus 20 volts as the stick is moved left or right and can be in any one of these modes.

(1) With the "bang-bang" stick, the simple switching stick which switches full voltage either way, the signal is a square wave-form with a center zero if the three-position control is selected.

(2) With the two-position control there is no center zero.

(3) With the proportional stick the voltage is in proportion to the angle through which the stick is moved either way. The signal will thus be of arbitrary wave-form following the movement of the stick.

4. Input Variables

a. Lead/Lag Shaping

As shown in Fig. 3, the stick signal is passed through a resistance-capacity network within the ZITA which imposes a time lag. This may be preselected at zero, one tenth, three tenths, one second and two seconds. Alternatively a phase advance, or time lead, may be introduced but this is significant only when the proportional stick is used. For this validation only the zero mode was utilized.

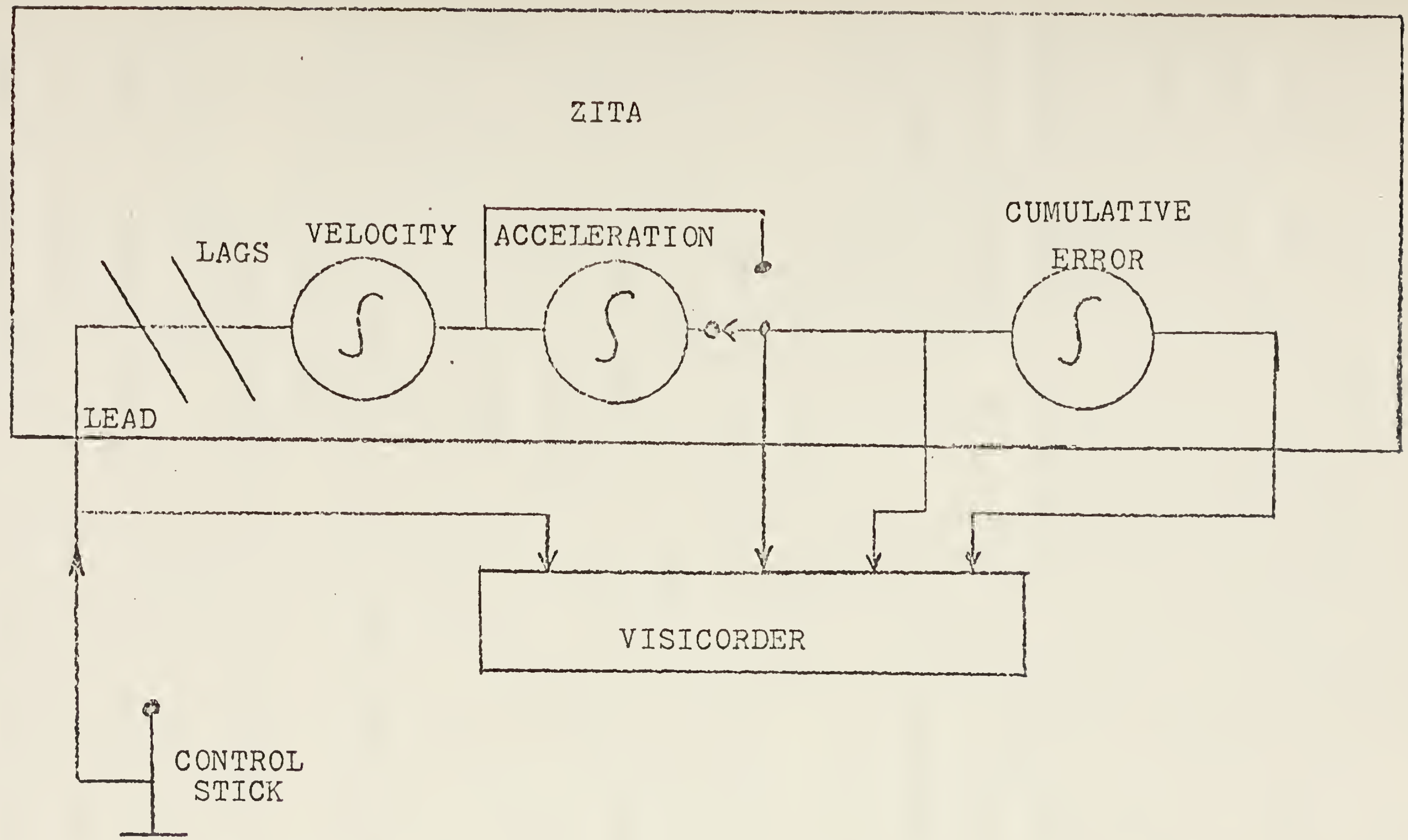

Figure 3. The ZITA - A Block Diagram

b. Velocity Response

The signal is next passed to the first integrator-amplifier which turns the square wave into a zig-zag on the display. The slope of the zig-zag is constant for any condition selected on the panel and has the appearance of a constant velocity across the scale of the display. The value of this velocity is called the "velocity stiffness" and may be predetermined by selecting the appropriate position of the error gain switch. This wave-form is displayed if "velocity" is selected on the panel. For this validation the error gain switch was always set on arbitrary setting of six.

c. The Acceleration Response

When "acceleration" is selected on the panel the signal goes through another stage of integration before being displayed. The excursions from zero are now parabolic with time, giving the appearance of a constant acceleration across the scale of the display. The value of this acceleration is called the "acceleration stiffness" and its value is predetermined by the position of the error gain switch.

d. The "error"

Any displacement of the display spot from the center of the scale is considered to be an "error." In the velocity response mode it is fairly easy to bring the spot to rest somewhere on the scale with the stick in the central (zero signal) position. With the three-position control stick, if the stick is left in the center position the error will remain zero. This situation can be avoided by using the

two-position control so that the spot always has velocity one way or the other.

When working with the acceleration response mode it is much harder for the subject to bring the spot to rest at zero error. With the spot traveling towards zero the subject would have to give opposite acceleration at precisely the right instant to destroy the velocity by the time the spot reached zero, and then immediately cancel this acceleration. Normally an overshoot occurs thus generating the oscillatory motion characteristic of this mode of tracking.

e. The Cumulative Error

Summation of the rectified error gives the Cumulative Error which is displayed on the read out paper. The error accumulated per 60 second cycle, or the slope of its curve over any shorter interval, is a measure of the modular mean error.

B. SUBJECTS

The subjects for the experiment were six male U. S. Naval Officers attached to Air Development Squadron One located at Paxtuent River, Maryland. Their ages ranged from 25 to 34 with an average age of 30. All were pilots (three helo, three P-3) with flight experience ranging from 400 - 3000 hours with 1600 hours the average. Due to the type mission that their squadron is involved in, they were familiar with the experimental style required to complete the experiment, but none had worked with the device (ZITA/ADT) or any other that

was similar. Subjects were familiar with the Low Pressure Chamber that was utilized and all had operationally used the oxygen mask. Judging from subjects discussion after the experiment no one knew whether or not he had been receiving 100% oxygen. All subjects were volunteers and no incentive was offered for their service.

C. PROCEDURES

The present evaluation was conducted in a standard U. S. Navy low pressure chamber (Model 9A2) located at the Aviation Physiology Unit of the Paxtuxent River Naval Air Station, Paxtuxent River, Maryland. Subjects were required to perform four separate tests sequentially. These tests were velocity response mode (V6), Velocity response mode with ADT (V6S), Acceleration response mode (A6), and Acceleration response mode with ADT (A6S), where the six refers to the error gain setting and the S refers to utilization of the ADT device as a stress factor. One hour later, after a rest period of approximately 50 minutes, the same sequence was repeated. This procedure was followed until each subject had completed six sets of tests. The entire process lasted about five hours each day and was done on four days at partial pressure altitudes of sea level, 5000 feet, 8000 feet, and again at 8000 feet. Due to lack of time and subjects this study did not delve into the effects of partial pressure. A diagram of the daily procedure is shown in Fig. 4.

Day 1	Sea Level
Day 2	5000' partial pressure
Day 3	8000' partial pressure
Day 4	8000' partial pressure

DAILY ROUTINE

Run	Tests/Rest Cycle	Start Time (hrs + min)
1	4 Test sequence	0 + 00
	Rest	0 + 10
2	4 Test sequence	1 + 00
	Rest	1 + 10
3	4 Test Sequence	2 + 00
	Rest	2 + 10
4	4 Test Sequence	3 + 00
	Rest	3 + 10
5	4 Test Sequence	4 + 00
	Rest	4 + 10
6	4 Test Sequence	5 + 00
	Conclusion	5 + 10

Figure 4. Daily Testing Layout

Three days prior to the validation-experiment all six subjects were briefed by the developer of the ZITA device, Mr. Norman K. Walker. Each subject was then given 30 minutes of individual instruction in actual use of the ZITA by Mr. Walker. This period was utilized to basically level out individual learning curves. The only background information about the testing was that the subject was to respond as accurately and as rapidly as possible.

During the four days of tests, subjects were not informed as to what partial pressure altitudes they were using other than the fact that they would be below 20,000 feet. After 4½ hours of partial pressure (30 minutes prior to the last test sequence) three of the subjects were given 100% oxygen and three were given ambient air. All six subjects were given this treatment via the standard Navy oxygen mask (MS 22001-6 manufactured by Sierra Engineering Company). Which subjects were given 100% oxygen and which were given ambient air was set up randomly, changing daily, and neither the subjects nor the experimenter knew until completion of the fourth day which subjects had received the different treatments.

D. DESIGN

The dependent variable from the ZITA experiment was the measurement of cummulative error over a one min cycle measured in tenths of millimeters (Appendix A). Each subject received all treatment combination in order to eliminate subject variability effects from masking treatment effects.

Data from the present experiment was analyzed by a four-way factorial analysis of variance (ANOVA) where the main factors were Subjects, Runs, Tests, and Days (6x6x4x4 design).

The actual analysis of the raw data was accomplished using an IBM Model 360 computer, utilizing a BMD08V Analysis of Variance method [Dixon, 1964]. This program performs analysis of variance for any hierarchical design with equal cell sizes and performs separate analysis on several variable simultaneously.

III. RESULTS

The results indicated a significant difference ($\alpha = .001$) within each of the four variables (Subjects, Tests, Runs, Days). (See ANOVA Table, Figure 5). Further evaluation was run on each of the variables by means of a Duncan Multiple Range test to determine where, within each variable, that a significant difference ($\alpha = .05$) existed. This along with interactions between variables is shown in Figs. 6-14 (low score indicating better performances). The results of the Duncan Test were as follows:

SUBJECTS

Subject six scored significantly better than all other subjects. Subject four scored significantly worse than all other subjects. As is shown in Fig. 6, the ZITA/ADT was able to discern among a group of individuals who the better performers were with respect to this particular psychomotor task. Also, as subject's scores were evaluated with respect to runs and days (Fig. 12 and 14), it became apparent that individuals have greatly different learning curves on this device.

DAYS

Day one was significantly worse than all other days. This is shown in Fig. 7 and it is again apparent that the learning curves did not level out until the third day.

RUNS

Run six is significantly better than Runs 1, 2, 3 and 5. Run four is significantly better than Runs 1 and 2. Run

Source	DF	MS	F	P
Subjects (I)	5	12639	16.86	.001
Days (J)	3	153961	24.96	.001
Runs (K)	5	20260	13.70	.001
Tests (L)	3	48344	7.51	.001
I x J	15	6168	8.23	.01
I x K	25	1479	1.97	.05
J x K	15	5109	3.30	.01
I x L	15	6438	8.59	.01
J x L	9	24479	9.68	.01
K x L	15	3565	9.33	.01
I x J x K	75	1548	2.06	.01
I x J x L	45	2528	3.37	.01
I x K x L	75	382	0.51	NS
J x K x L	45	1017	1.36	.2
I x J x K x L	225	750		
Total	575			

Figure 5. Four Way Analysis of Variance

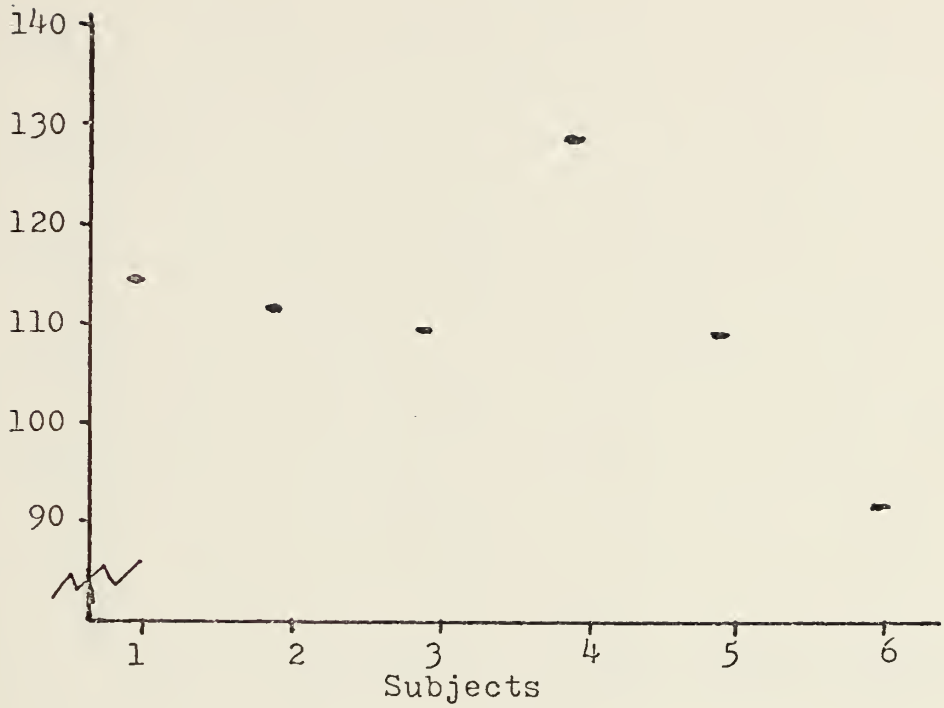

Figure 6. Cell Means by Subject

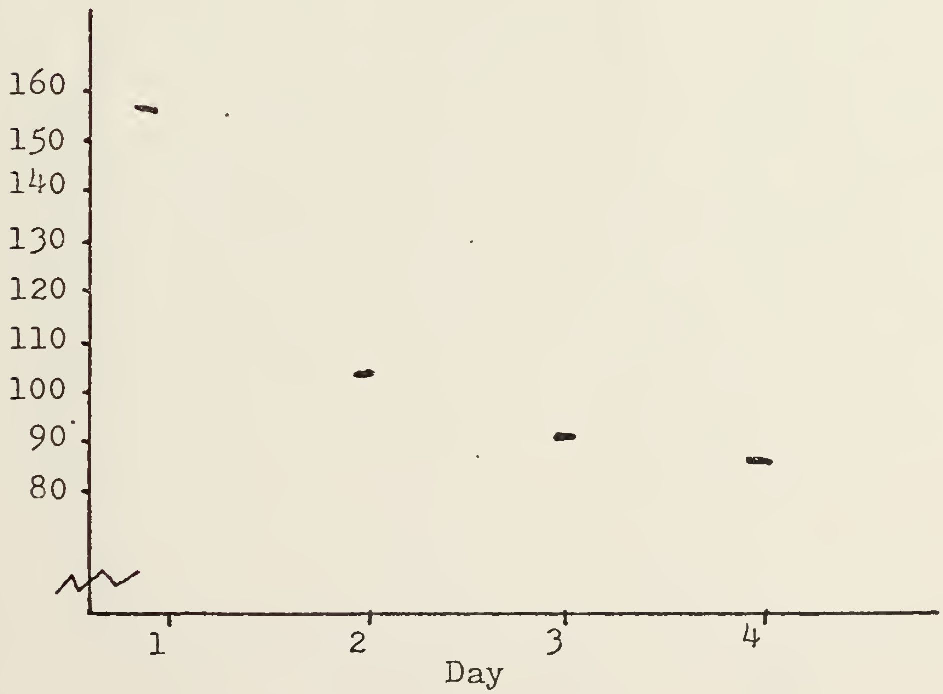

Figure 7. Cell Means by Days

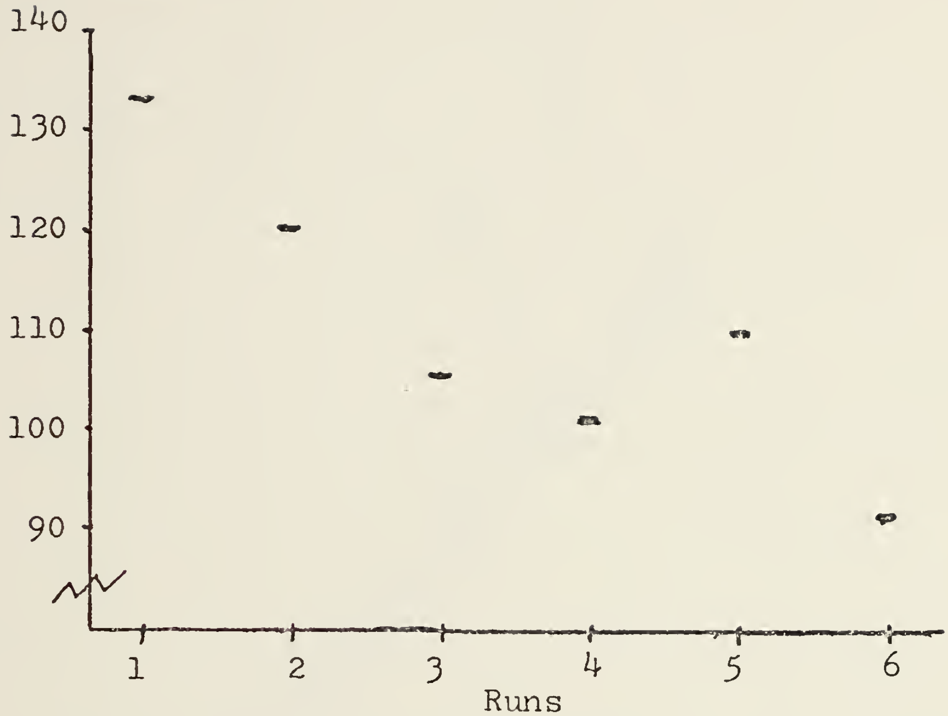

Figure 8. Cell Means by Runs

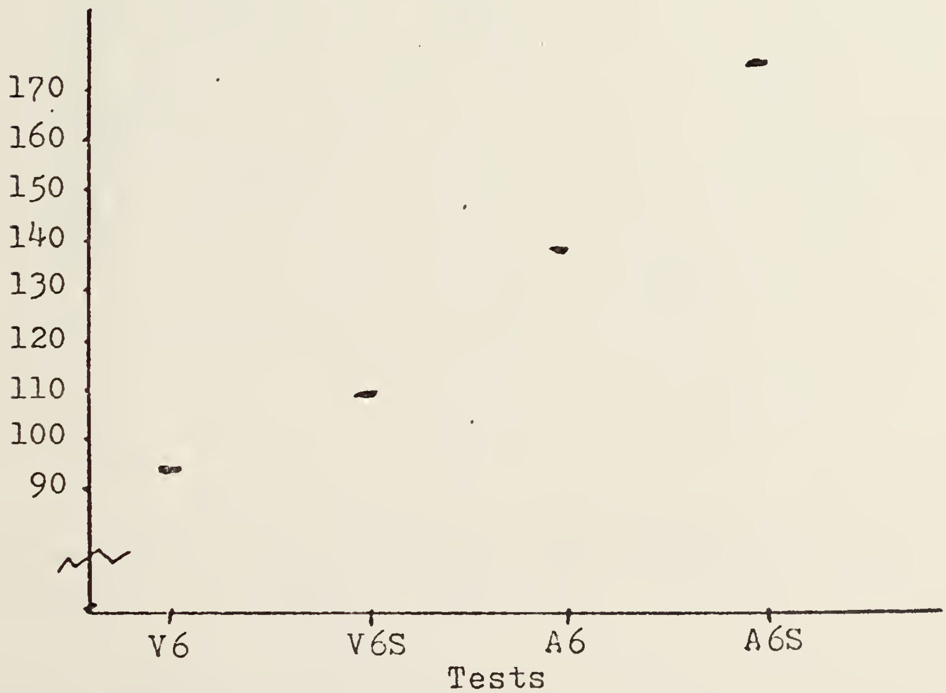

Figure 9. Cell Means by Tests

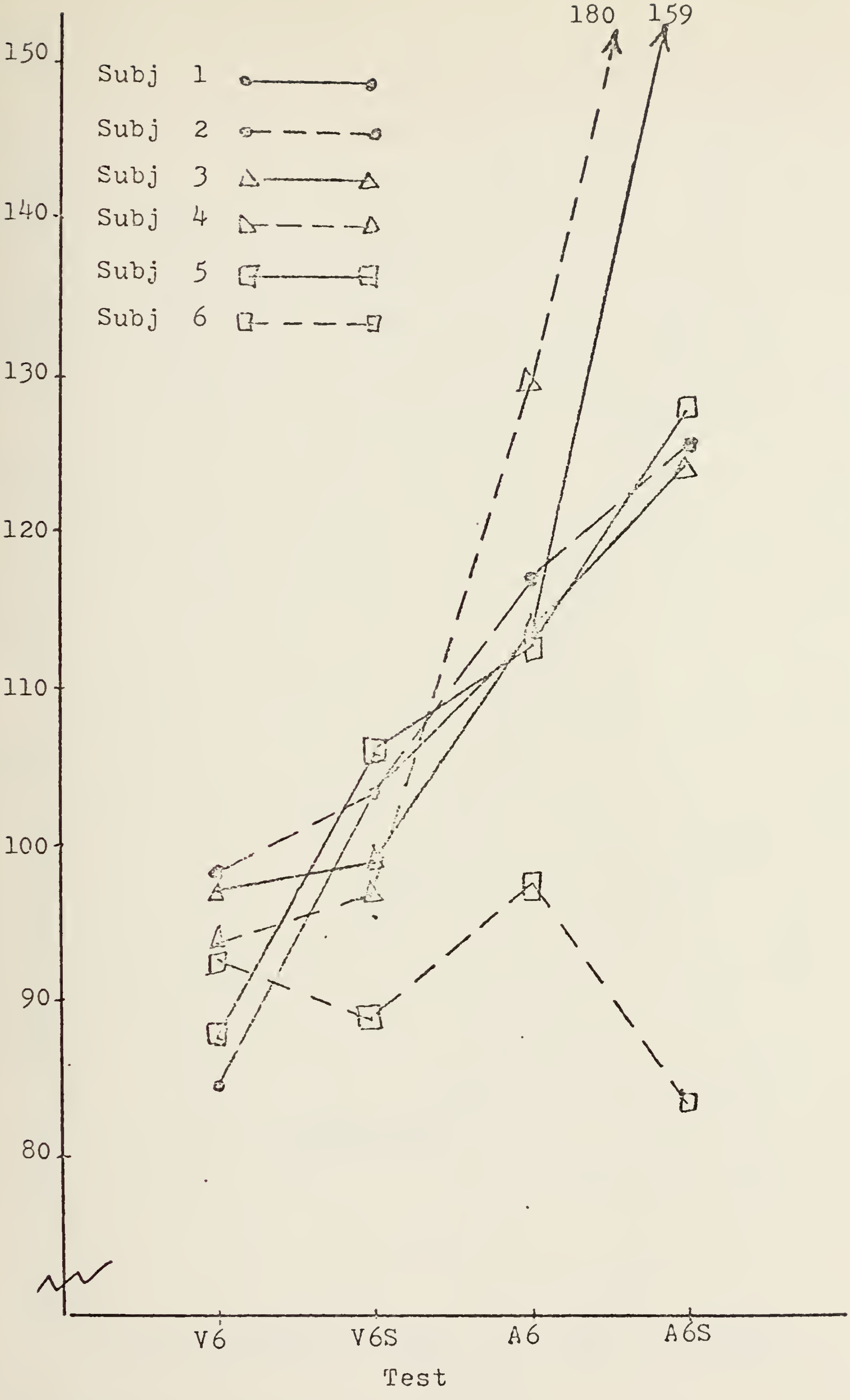

Figure 10. Subject by Test Graph

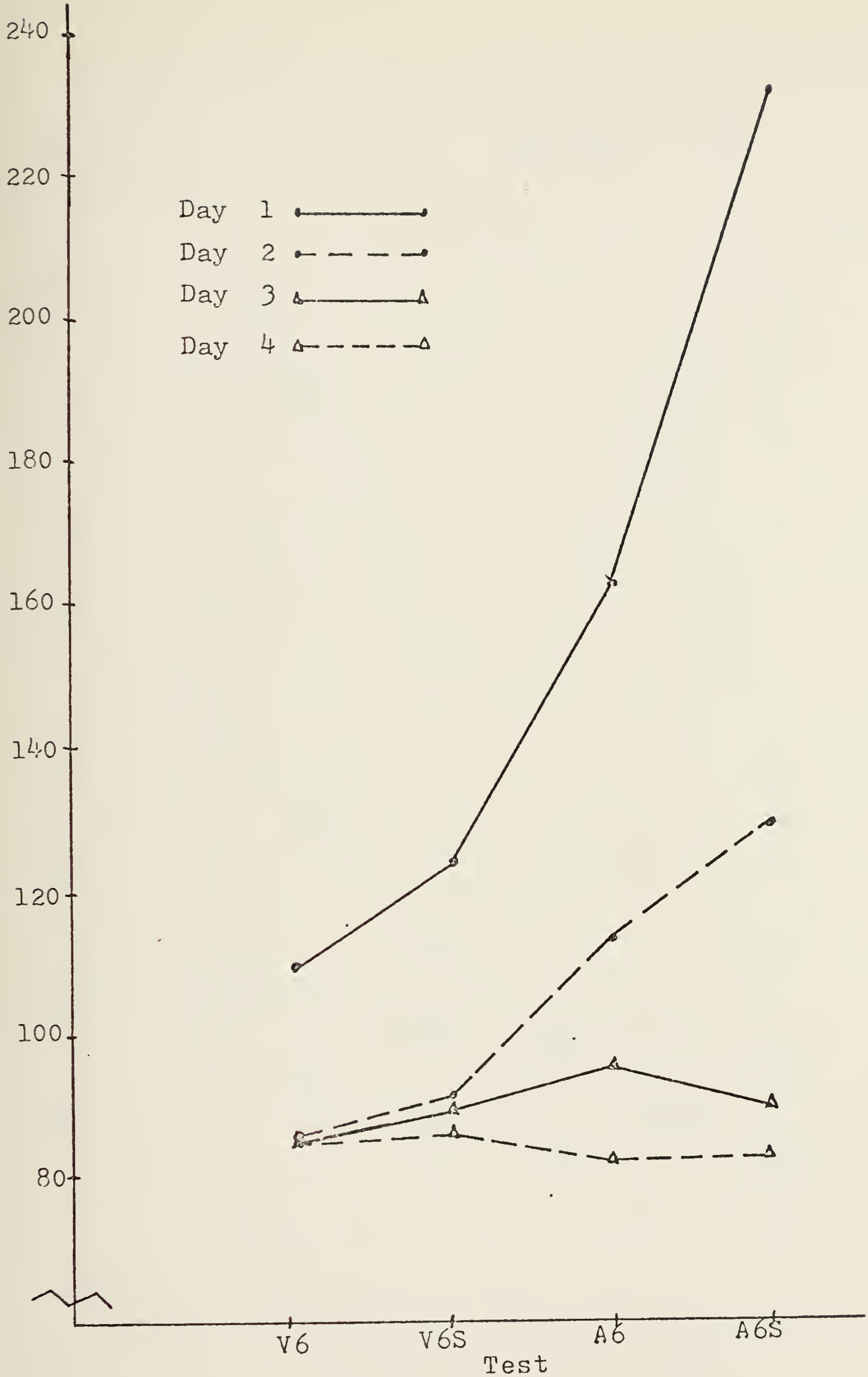

Figure 11. Day by Test Graph

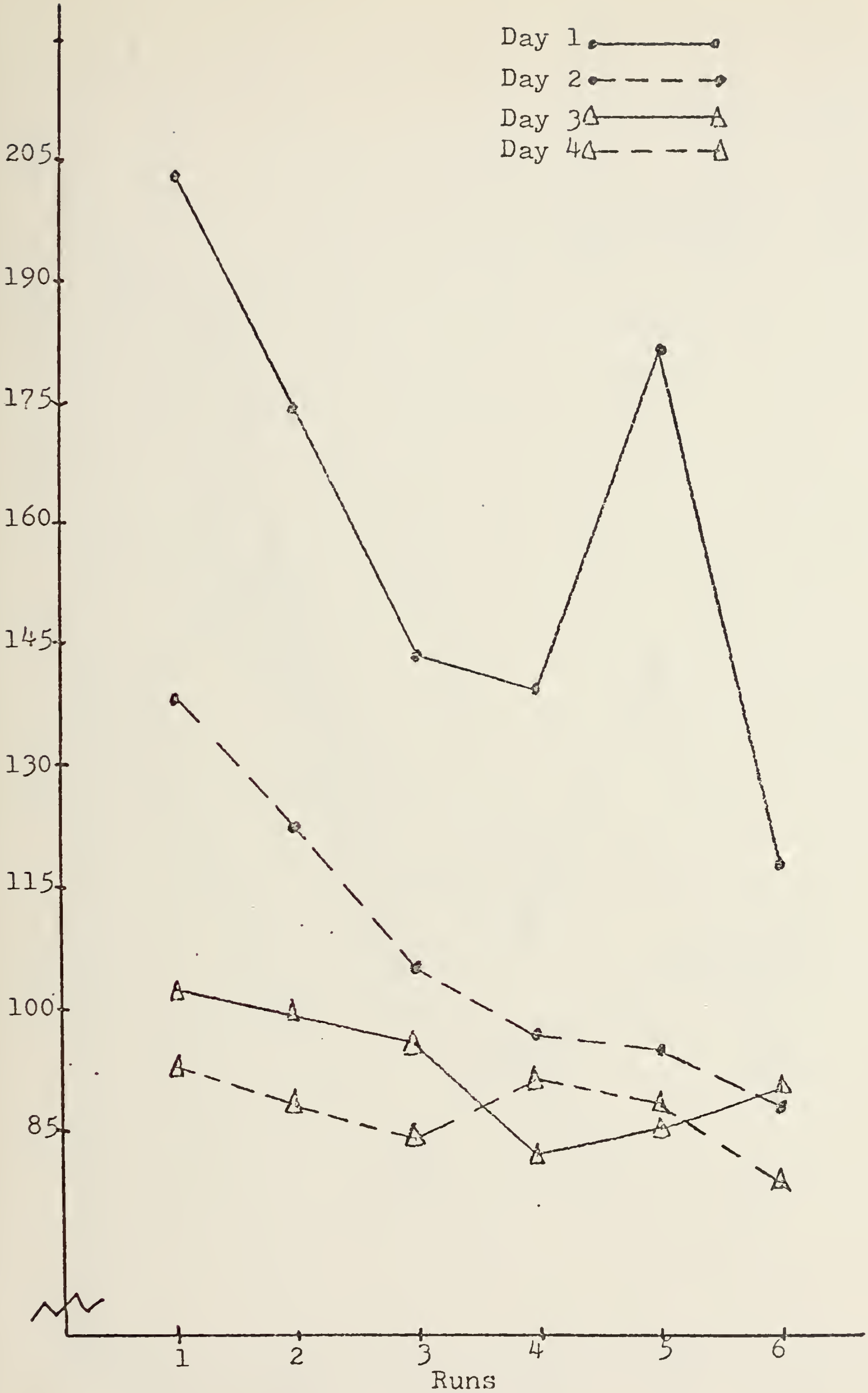

Figure 12. Day by Runs Graph

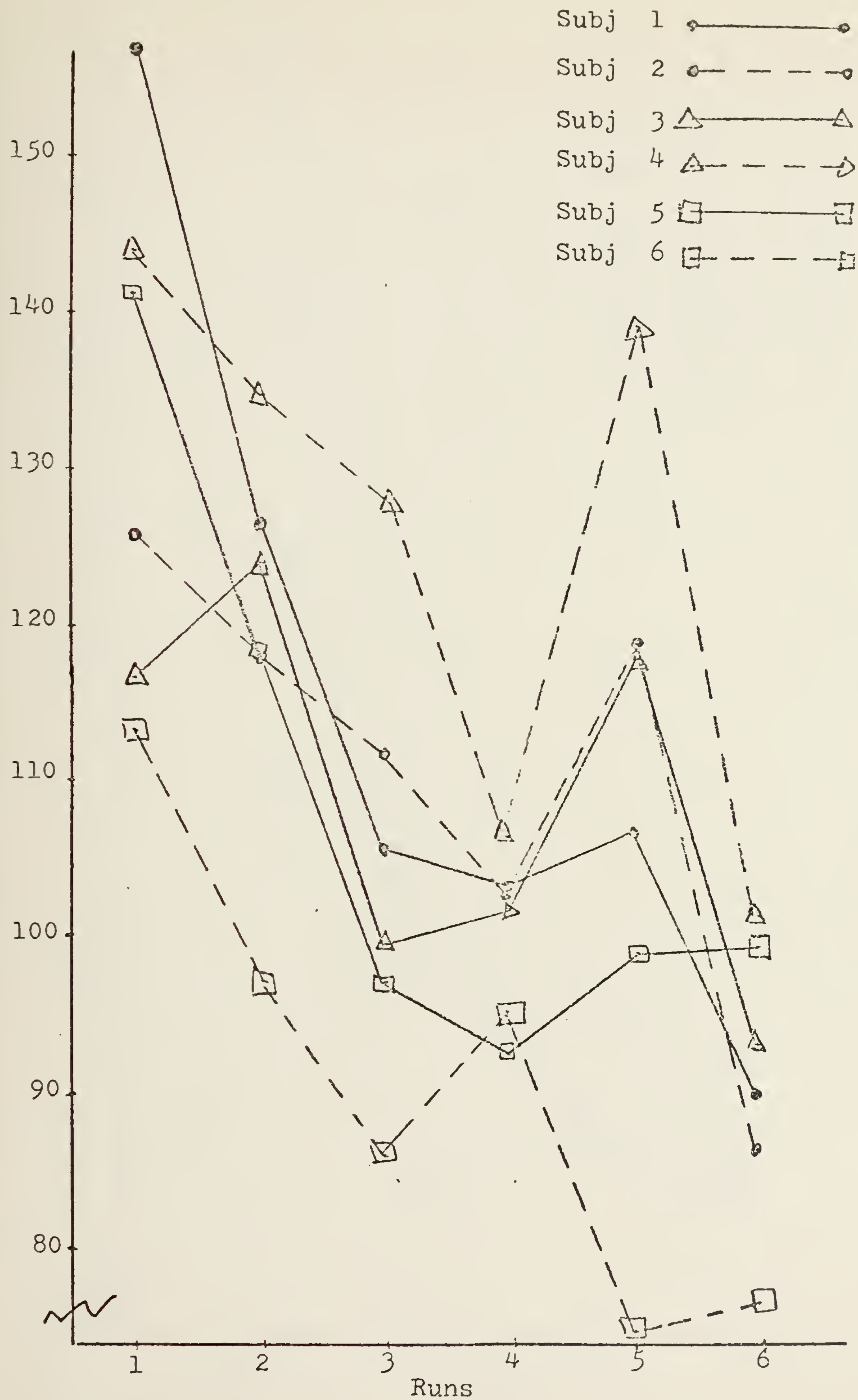

Figure 13. Subject by Runs Graph

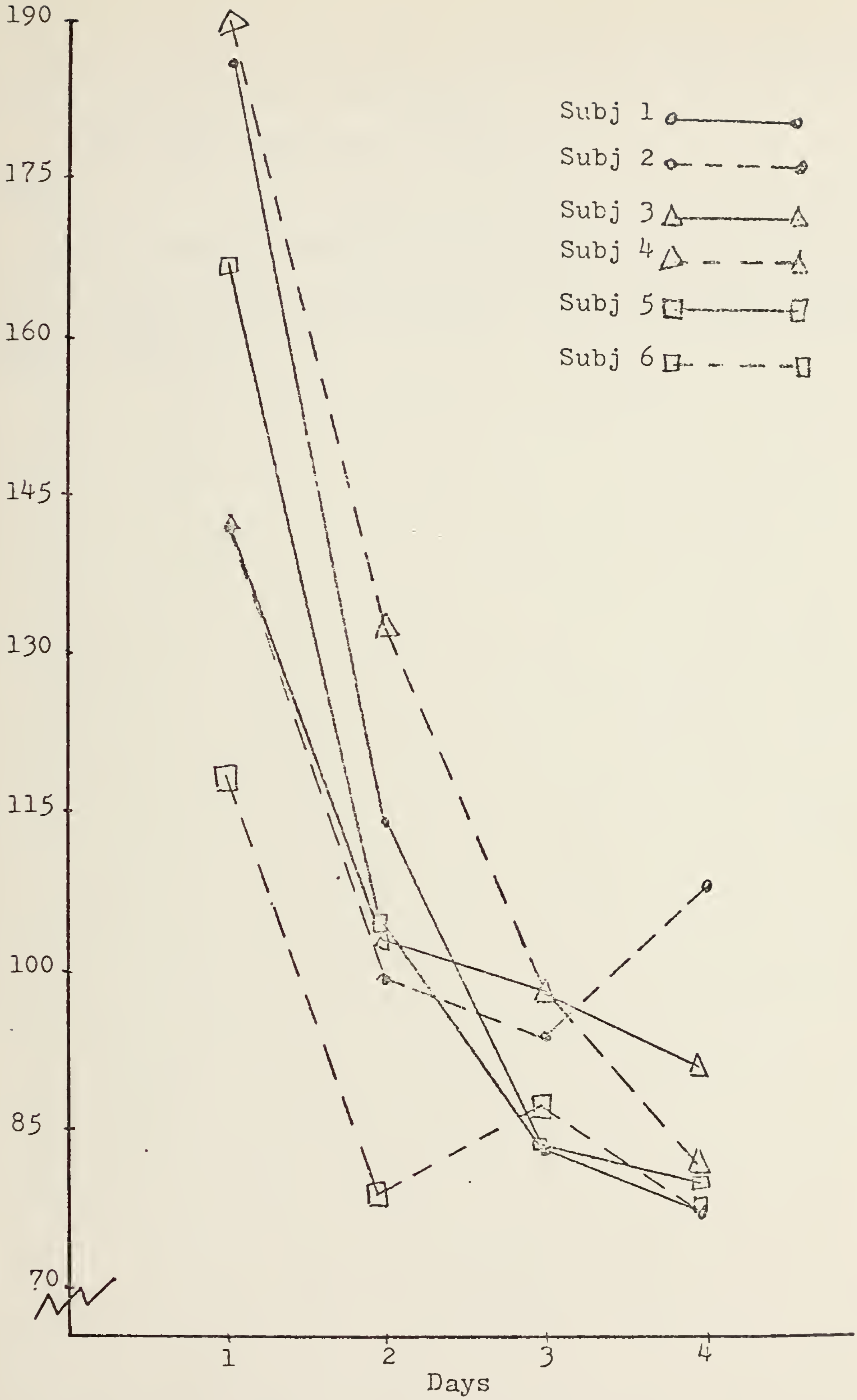

Figure 14. Subject by Days Graph

three is significantly better than Runs 1 and 2. Run two is significantly better than Run 1.

These facts are shown in Fig. 8.

TESTS

A6S is significantly more difficult than A6, V6S, or V6. A6 is significantly more difficult than V6. These facts are shown in Fig. 9.

IV. CONCLUSIONS

As the primary objective of this experiment was to determine the validity of the ZITA/ADT machine, this was the area in which most of the effort was envolved. As shown in the results, the machine did prove successful in achieving consistent and significant results with respect to measurement of a particular psychomotor task. Also, as shown in the results as subjects were evaluated with respect to runs and days it became apparent that individuals have greatly different learning curves on this device. In several cases it required almost two hours of practice (third day) before the learning curve was leveled out on the acceleration tests (A6, A6S). This was well beyond the 10-15 minutes predicted by the developer prior to the running of the experiment. Depending upon the type of predicting for which a certain test battery is developed, the shape and slope of the learning curve could be used to great advantage; or, lack of knowledge of the curve could lead to erronous results. Different levels of partial pressure oxygen up to 8,000 feet had no degradating effects on performance of the psychomotor skill over a five hour period. Over each individual day though, there was a significant degradation around the fourth hour. In almost all cases the sixth, or last, run was significantly better than all previous runs. This fact can probably be explained by psychological reasoning rather than by physiological functions: i.e. the improvement

due to motivation caused by end of test period, the subjects impression that he was receiving oxygen and this would increase his performance, etc.

The major outcome of the testing was the information obtained about the four different tests (V6, V6S, A6, A6S). As was shown from the results, there is no significant difference between the velocity mode and the velocity mode stressed (V6, V6S), but there was a significant difference between the velocity mode (V6) and the acceleration mode (A6) and also between the velocity stressed mode (V6S) and the acceleration stressed mode (A6S). Because of these facts, it is recommended that testing batteries only utilize the velocity mode (V6) vs. acceleration mode (A6), or velocity stressed mode (V6S) vs. acceleration stressed mode (A6S) if a comparison is desired on how a subject responds between the two modes of velocity and acceleration. If a comparison is not desired and yet more than one test is desired it is recommended that the batteries utilize V6, A6, and A6S.

It is further recommended that a follow-on evaluation be done with the following areas:

1. Increase the error gain switch to a setting beyond six (which was used all the time) and evaluate the various outcomes.

2. Increase the stressing factor from the ADT. Rather than having only a binominal decision, high or low tone, a system could be developed involving a greater decision process, which should in turn degrade the tracking ability of the subject due to time-sharing process.

3. Decrease the partial pressure with respect to oxygen in order to observe hypoxic effects.

One area in which the ZITA/ADT could possibly be a major factor would be as a predicter in the selection of student aviators. Along this view, it is recommended that a follow-on study be done in which perspective student aviators be given a battery of tests prior to entering flight training. Then, when it is known the final standing of those that finish the flight program and those that fail, it could be established to what degree, if any, the ZITA/ADT correlates to actual outcome for the flight program.

APPENDIX A: RAW DATA

SUBJECT 1

Day	Run	V6	V6S	A6	A6S
Day 1	1	9.5	26.0	25.0	43.2
	2	8.6	13.4	20.8	39.6
	3	11.8	10.8	15.8	31.0
	4	16.6	11.6	13.2	20.1
	5	9.2	17.0	16.8	24.9
	6	8.4	9.4	14.6	27.8
Day 2	1	13.8	12.7	20.0	26.3
	2	6.8	9.2	13.3	21.5
	3	7.0	8.6	9.6	15.3
	4	6.8	8.2	8.8	13.2
	5	7.6	10.0	7.2	16.3
	6	9.6	8.3	5.2	8.2
Day 3	1	7.7	10.2	9.6	10.8
	2	7.7	9.8	7.1	10.4
	3	6.9	7.9	9.9	4.0
	4	6.8	8.4	10.8	6.9
	5	7.1	7.7	11.2	10.3
	6	6.4	8.3	7.6	6.1
Day 4	1	7.5	8.5	9.8	9.7
	2	7.3	8.3	9.5	8.6
	3	7.4	9.0	7.1	7.0
	4	8.1	8.1	9.8	7.8
	5	7.0	8.1	4.7	6.0
	6	6.9	7.4	4.8	5.8

SUBJECT 2

Day	Run	V6	V6S	A6	A6S
Day 1	1	11.2	11.4	20.6	23.3
	2	11.6	10.5	17.7	19.6
	3	13.0	11.0	13.5	19.8
	4	10.9	10.0	13.8	10.3
	5	16.3	19.3	13.7	24.5
	6	9.3	9.8	7.3	10.1
Day 2	1	12.1	11.7	14.0	11.8
	2	9.1	9.0	15.2	15.3
	3	8.8	8.9	8.6	8.2
	4	9.3	10.1	10.7	10.5
	5	7.9	9.0	8.6	8.6
	6	7.4	8.9	7.8	7.5
Day 3	1	9.1	9.2	12.6	12.3
	2	8.4	8.6	7.9	10.4
	3	9.2	10.2	7.2	8.2
	4	9.6	8.7	6.7	9.8
	5	9.0	8.8	13.4	7.7
	6	7.8	9.6	13.2	7.8
Day 4	1	11.2	9.6	9.8	11.0
	2	8.4	9.8	11.8	14.8
	3	8.7	11.5	14.4	17.8
	4	10.3	11.6	12.1	10.5
	5	8.9	10.2	10.5	13.5
	6	7.6	8.7	8.6	7.5

SUBJECT 3

Day 1	Run	V6	V6S	A6	A6S
	1	11.1	14.7	13.8	14.6
	2	10.4	9.2	20.0	19.5
	3	11.2	9.0	8.9	13.1
	4	8.1	9.9	13.1	30.4
	5	19.0	22.1	20.6	24.6
	6	7.7	8.9	11.8	8.9
Day 2					
	1	9.5	10.7	18.0	9.3
	2	11.5	10.7	15.9	13.5
	3	8.0	8.5	7.5	14.0
	4	8.1	7.7	9.0	9.5
	5	8.1	6.9	10.4	8.3
	6	9.7	10.1	9.2	12.2
Day 3					
	1	8.2	8.8	8.3	13.8
	2	10.3	8.8	16.4	17.9
	3	8.7	9.4	15.3	12.6
	4	7.8	8.2	9.2	5.4
	5	7.9	7.7	5.9	8.2
	6	8.8	7.9	9.2	10.7
Day 4					
	1	9.7	11.0	9.8	14.4
	2	8.4	8.3	8.0	9.0
	3	9.5	7.9	3.6	8.1
	4	10.4	10.8	10.4	5.0
	5	11.5	10.7	9.3	7.8
	6	9.6	9.1	8.8	7.0

SUBJECT 4

Day 1	Run	V6	V6S	A6	A6S
	1	8.0	15.8	23.4	36.1
	2	10.8	9.4	20.5	49.0
	3	8.4	9.4	18.2	38.5
	4	8.8	8.4	12.3	21.2
	5	22.1	21.1	25.6	30.9
	6	8.0	7.5	15.6	26.8
Day 2	1	8.0	11.2	18.1	27.8
	2	8.9	9.8	12.2	22.2
	3	8.8	8.4	13.0	23.3
	4	7.6	7.7	17.5	21.8
	5	8.2	8.0	16.6	20.2
	6	7.7	7.2	11.3	11.8
Day 3	1	8.7	9.5	14.0	17.8
	2	9.4	10.3	12.6	7.7
	3	9.7	9.0	15.7	13.2
	4	9.1	8.3	5.6	5.6
	5	8.2	8.3	7.6	11.0
	6	9.7	11.5	6.8	6.9
Day 4	1	9.9	9.5	6.1	6.1
	2	8.1	7.5	6.3	10.3
	3	9.3	8.2	6.0	5.4
	4	9.3	8.9	10.1	8.0
	5	9.5	8.9	5.7	11.2
	6	8.5	8.5	8.5	6.6

SUBJECT 5

Day 1	Run	V6	V6S	A6	A6S
	1	13.6	22.3	25.0	33.0
	2	8.5	11.4	19.8	30.3
	3	8.2	12.2	14.1	24.5
	4	9.5	11.2	12.8	22.1
	5	10.4	13.7	19.6	19.6
	6	7.8	10.7	21.2	17.5
Day 2					
	1	9.2	11.2	16.6	24.0
	2	7.7	9.7	16.6	19.5
	3	8.0	8.8	15.5	7.6
	4	8.5	8.6	6.4	5.7
	5	8.1	10.6	6.2	7.2
	6	8.0	9.6	5.6	9.5
Day 3					
	1	13.4	9.8	8.2	6.5
	2	9.1	10.0	6.6	7.2
	3	7.3	10.3	8.2	6.2
	4	8.6	9.8	4.5	8.2
	5	8.1	8.7	5.8	5.9
	6	8.6	10.3	11.9	6.6
Day 4					
	1	8.0	9.9	8.2	6.2
	2	7.4	8.5	8.4	7.7
	3	8.0	7.7	5.8	6.8
	4	8.7	9.9	6.5	6.8
	5	8.3	9.0	8.4	9.2
	6	7.1	9.1	8.1	8.3

SUBJECT 6

Day	Run	V6	V6S	A6	A6S
Day 1	1	13.3	14.7	22.0	34.5
	2	10.3	9.4	18.0	17.0
	3	10.9	9.4	9.1	6.4
	4	12.5	12.9	12.7	11.4
	5	10.0	7.8	9.8	4.2
	6	9.2	8.3	5.2	5.2
Day 2	1	8.5	8.4	9.5	4.2
	2	8.2	8.1	7.5	6.7
	3	9.6	7.9	10.8	7.0
	4	7.1	8.8	11.6	5.3
	5	7.6	7.8	5.7	4.7
	6	10.3	7.6	7.6	7.0
Day 3	1	8.6	8.2	8.8	6.2
	2	8.3	9.3	12.5	6.7
	3	8.4	8.8	7.2	10.6
	4	8.1	8.3	8.7	13.2
	5	9.2	8.2	9.2	6.3
	6	8.1	9.1	10.6	6.8
Day 4	1	8.9	8.9	9.1	6.6
	2	8.4	7.7	8.0	8.1
	3	9.6	8.6	7.3	6.1
	4	8.2	8.8	8.3	6.7
	5	9.1	8.0	7.4	4.5
	6	9.3	7.5	7.1	4.0

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